

## REMARKS

In response to the Final Office Action mailed May 5, 2006, Applicant respectfully requests reconsideration. Claims 1-57 remain pending in the present application.

### Claim Rejection Under 35 U.S.C. § 102

In the Office Action, the Examiner rejected claims 1-57 under 35 U.S.C. 102(b) as being anticipated by “Finite Newton Method for Lagrangian Support Vector Machine Classification” by Fung et al., Data Mining Institute Report, 02-01, February 2002 (Fung). Applicant respectfully traverses the rejection. Fung fails to disclose the claimed invention, as required by 35 U.S.C. 102(b), and provides no teaching that would have suggested the desirability of modification to include such features.

Fung does not disclose or suggest defining a linear programming formulation of a support vector machine classifier, solving an exterior penalty function of a dual of the linear programming formulation to produce a solution to the support vector machine classifier, and selecting an input set for the support vector machine classifier based on the solution, as set forth in claims 1-15 and 46-48. Fung also does not suggest a computer-readable medium storing instructions to cause a processor to perform such functions, as recited in claims 31-45 and 52-54.

Fung also lacks any teaching that would have suggested a classification system comprising a processor that applies a linear programming formulation of a support vector machine classifier to classify data based on an input set, and an input module that generates the input set based on a solution of an exterior penalty function of a dual of the linear programming formulation, as defined by claims 16-30 and 49-51.

In addition, Fung fails to disclose or suggest a support vector machine classification system comprising a data storage medium storing input data for classification, a support vector machine classifier that classifies the input data into a first set of data and a second set of data based on a set of input features, and a selection module that produces a reduced set of input features for the support vector machine classifier based on a minimization of an exterior penalty function of a dual of a linear programming formulation of the linear support vector machine classifier for a finite value of a penalty parameter, as set forth in claims 55-57.

In the previous response filed February 1, 2006, Applicant pointed out that Fung does not disclose the use of a linear programming formulation of a support vector machine classifier. On the contrary, as described by Applicant at paragraph [0028] of the disclosure, Fung describes a quadratic programming formulation of a support vector machine. In the vicinity of page 3, paragraph 2, line 9, Fung reads as follows:

with ones or minus ones along its diagonal. For this problem, the standard support vector machine with a linear kernel  $AA'$  [27, 3] is given by the following quadratic program for some  $\nu > 0$ :

$$\begin{aligned} \min_{(w, \gamma, y) \in R^{n+1+m}} \quad & \nu e'y + \frac{1}{2} w'w \\ \text{s.t.} \quad & D(Aw - e\gamma) + y \geq e \\ & y \geq 0. \end{aligned} \quad (2)$$

In the above passage, Fung clearly refers to a quadratic program for a support vector machine. A quadratic programming formulation is nonlinear. A quadratic programming formulation, unlike a linear programming formulation as claimed, does not generate sparse solutions and hence does not suppress input features. This characteristic of a nonlinear, quadratic programming formulation contrasts with the strong feature suppression property possible with a linear programming formulation as claimed.

Despite Applicant's previous attempt to clarify the content of the Fung reference, the Examiner again relied on the very same passage in Fung. In particular, the Examiner pointed to page, 3, paragraph 2, line 9, of Fung, and asserted that this passage discusses defining a linear programming formulation of a support vector machine classifier. As discussed above, in this passage, Fung describes the use of a quadratic programming formulation of a support vector machine classifier.

The quadratic programming formulation described by Fung may be applied to a linear or nonlinear support vector machine classifier, which could be the source of the Examiner's confusion. In the Fung reference, however, the programming formulation itself is quadratic, i.e., nonlinear, as previously explained by Applicant. In other words, in Applicant's claims, the linear requirement pertains to the programming formulation, and not the support vector machine.

In the Examiner's reply to Applicant's arguments, the Examiner merely restated the language from Applicant's claims and again pointed to page 3, paragraph 2, of Fung. The Examiner also cited page 12 of Fung, which includes code for implementation of a finite Newton linear support vector machine. However, even though page 12 of Fung mentions that the programming formulation may result in a linear or nonlinear support vector, the programming formulation itself is nonlinear, in contrast to the requirements of Applicant's claims.

The Examiner provided no other explanation and, more particularly, did not address Applicant's argument that Fung discloses a quadratic, i.e., nonlinear, programming formulation. In light of Applicant's clarification of Fung, and the lack of any rebuttal by the Examiner, it is unclear how the Examiner could continue to rely on Fung as an anticipatory reference with respect to Applicant's claims. The fundamental differences identified above make clear that Fung does not disclose or suggest the invention defined by Applicant's claims. Therefore, Applicant respectfully requests withdrawal of the rejection under section 102 in view of Fung.

Applicant does not admit or acquiesce in the propriety of the Examiner's characterization of the Fung reference relative to any other requirements of Applicant's claims, including the additional requirements set forth in the dependent claims. In view of the differences between Fung and the inventions defined by the independent claims, however, it is not necessary at this time to discuss the further differences presented by the dependent claims.

Applicants respectfully request that the Examiner provide further explanation concerning the interpretation of Fung, and specifically address Applicant's position that Fung does not disclose a linear programming formulation of a support vector machine classifier.

### **Claim Rejection Under 35 U.S.C. § 101**

In the Office Action, the Examiner rejected claims 1-57 under 35 U.S.C. 101 as being directed to non-statutory subject matter. Applicant respectfully traverses this rejection. Applicant's claims define statutory subject matter for purposes of 35 U.S.C. 101. The Examiner's analysis in support of the rejection under section 101 relies on both legal and factual errors.

In terms of legal error, the Examiner focused on only one aspect of the claimed invention, rather than the invention as a whole.<sup>1</sup> In particular, the Examiner repeatedly noted the presence of the phrase “linear programming formulation” in the claims, and characterized it as an abstract idea. However, the Examiner did not properly consider whether the claimed invention as a whole is directed to a practical application. In particular, the Examiner characterized the claimed invention as a manipulation of an abstract idea in the form of a programming formulation. Yet, the Examiner ignored the practical application expressed in the claims, i.e., selection of an input set for a support vector machine classifier to carry out data classification.

In addition, the Examiner elevated the requirement of practical application above the level required by the law. In particular, the Examiner stated that the claims do not refer to any substances that are transformed or reduced, nor any specific data representing physical objects or activities. The Examiner concluded that, because “data classification” is not qualified by specific data representing physical objects or activities that are being transformed, the application of the claimed invention is not a practical application. As will be discussed in further detail below, the practical application in this instance is data classification per se, similar to applications for data encryption, encoding, or compression. Specification of the actual data that is classified is not necessary to demonstrate the practical application of the underlying invention.

The claimed invention clearly defines a practical application. In so doing, the claimed invention need not physically transform any material or article.<sup>2</sup> Rather, it is sufficient that the claimed invention produce a useful, concrete and tangible result.<sup>3</sup> To that end, the various claims are directed to a method, apparatus, system and article of manufacture useful in data classification. Although the claimed invention may rely in part on mathematical relationships and computing techniques, it presents a practical application of such relationships and techniques to data classification. In refusing to recognize data classification by a support vector machine classifier as a practical application, the Examiner’s analysis relies on factual error.

The subject matter of the claimed invention clearly provides a useful result, i.e., identification of different classes of data within a larger set of data. Data classification may be

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<sup>1</sup> *In re Alappat*, 31 USPQ2d 1545 (Fed. Cir. 1994).

<sup>2</sup> *AT&T Corp. v. Excel Communications, Inc.*, 50 USPQ2d 1447 (Fed. Cir. 1999).

<sup>3</sup> *State Street Bank & Trust Co. v. Signature Financial Group, Inc.*, 47 USPQ2d (Fed. Cir 1998).

used in a wide variety of fields including, for example, data mining, medical diagnosis, medical prognosis, fraud detection, intrusion detection, credit evaluation and gene expression.

The result provided by the claimed invention is also concrete within the meaning of section 101. In particular, the data classification results are concrete in the sense they provide a repeatable, predictable result in classifying data into different classes. Accordingly, there should be no question that the claimed invention provides a concrete result.

Finally, the claimed invention also provides a tangible result. Neither section 101 nor the case law require that, to be tangible, a claim be tied to a particular machine or apparatus or operate to change articles or materials to a different state or thing.<sup>4</sup> On the contrary, the result must be tangible in the sense that the claimed invention provides a practical application.

The claimed invention does not simply manipulate abstract ideas. The fact that the claims recite the use of a linear programming formulation does not mean that the claims merely define an abstract idea. On the contrary, the linear programming formulation is one aspect of the claimed invention as a whole, which applies the linear programming formulation to produce a reduced input set for use by a support vector machine classifier in classifying data.

In particular, the claims require selection of an input set for a support vector machine classifier based on a solution to an exterior penalty function of a dual of a linear programming formulation of the support vector machine classifier. The selection of an input set for a support vector machine classifier is not an abstract idea per se, nor merely a mathematical algorithm in the abstract. Rather, the claimed invention defines a solid technique for data component reduction.

As described in Applicant's disclosure, a support vector machine (SVM) classifier is a tool for data classification and is often used for data mining operations. To enhance performance of an SVM classifier, it is desirable to make the input set used to define the separating surface applied by the SVM classifier as small as possible. The input set for an SVM classifier may present thousands, or even millions, of data points, and each data point may consist of hundreds of components. The claimed invention permits suppression of the input set components to substantially enhance the performance of an SVM classifier.

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<sup>4</sup> *AT&T Corp. v. Excel Communications, Inc.*, 50 USPQ2d 1447 (Fed. Cir. 1999).

As mentioned above, identification of the particular type of data classified by the SVM classifier is not necessary to support a practical application. Rather, the practical application of the claimed invention is data classification itself. This is similar to an invention relating to data encryption, encoding or compression. In those cases, mathematical expressions are applied to encrypt, encode or compress data, without necessary regard to the particular nature of the data.

The practical application of the claimed invention is data classification, much like the practical application of a data encryption process is encryption, without regard to the type of data that is encrypted. On a similar note, the practical application of a fluid handling device is fluid handling, regardless of the particular type of fluid that is handled. To view the practical application in terms of the type of data that is classified misses this point.

Moreover, even if application to a particular type of data were necessary, various dependent claims are even more specific. For example, dependent claims 46, 49 and 52 recite application of a support vector machine classifier to classify data relating to one of fraud detection, credit evaluation, gene expression, intrusion detection, medical diagnosis or medical prognosis. Similarly, claims 47, 50 and 53 recite applications of a support vector machine classifier to classify data relating to absolute call measurements for multiple myeloma, and claims 48, 51 and 54 recite application of a support vector machine classifier to classify data relating to absolute call measurements for multiple myeloma. Clearly, such claims contemplate a practical application that yields a useful, tangible and concrete result.

In the Office Action, the Examiner dismissed the recitation in claims 46-54 as merely pertaining to a field of use. Applicant strongly disagrees. If a tangible result requires specification of a particular type of data representing physical objects or activities, a point which Applicant disputes, then claims 46-54 surely meet such a requirement. The Examiner provided no basis whatsoever for his dismissal of such claims as being directed merely to a field of use. Yet, qualification of the type of data seems to be exactly what the Examiner believes is required for statutory subject matter. Therefore, the Examiner's analysis is inconsistent.

If fraud detection, credit evaluation, gene expression, intrusion detection, medical diagnosis or medical prognosis data does not further limit the claimed invention to a particular, practical application, then it is unclear to Applicant what more the Examiner might require. Medical diagnostic data, for example, clearly represents data useful in medical diagnosis and

limits the claimed invention to the practical application of classification of medical diagnostic data. Likewise, gene expression data limits the claimed invention to the practical application for classification of gene expression data. Moreover, it is unclear how the Examiner could simply dismiss the additional requirements of claims 47, 50 and 53, which specify the particular application of the support vector machine classifier to classify data relating to absolute call measurements for multiple myeloma. Claims 48, 51, and 54 even further limit the claims to the practical application of classifying data relating to absolute call measurements for multiple myeloma.

The basis for Examiner's dismissal of such limitations as merely representing a field of use is unclear. In particular, Applicant can find no basis in the law for the proposition that a practical application of a claimed invention can be dismissed as a field of use. If this were the appropriate rationale, Applicant questions how the Examiner would distinguish between data relating merely to "dollar amounts," per *State Street*, and data relating more particularly to absolute call measurements for multiple myeloma, as claimed by Applicant. Applicant respectfully requests that the Examiner cite proper authority to justify his disregard for the practical applications recited in claims 46-54. Absent citation of such authority, the rejection should be withdrawn.

Applicant respectfully submits that the Office Action seems to place undue emphasis on the presence of a linear programming formulation in the claims, and overlooks the application of the linear programming formulation in reducing the input set components for a support vector machine classifier to enhance data classification performance. Upon realization that the claimed invention is not directed to an abstract idea per se, but rather a practical application of mathematical relationships to perform data classification, it should be clear that the claimed invention defines statutory subject matter under section 101.

As mentioned in the previous response, the Examiner has identified a number of U.S. patents with claims relating to data classification. Two examples are U.S. Patent Nos. 6,112,195 and 6,134,344, both to Burges, which include claims relating to the use of data classifiers such as support vector machines. Claim 1 of the '195 patent, for example, recites incorporating a local invariance in such a way that a resulting dimension of each feature vector in a kernel-based classifier system (e.g., a support vector machine) is fixed and that the dimension is equal to the

dimension of input data minus the number of degrees of freedom in the local invariance, wherein the input data is of dimension N and the provided data is of dimension M, where M>N. The invention claimed in the '195 patent to Burges certainly makes use of mathematical relationships. Like the invention claimed by Applicant, however, the Burges invention is directed to the practical application of such relationships to a data classifier.

In reply, the Examiner stated that “[a]ll patents issued stand on their own merits and are not subject matter for justification of allowance in other applications.” The Examiner further stated that the “justification for allowance . . . is found in current statutes [sic], appropriate case law and USPTO policy.” Yet, Applicant contends that the identified patents represent the proper application of the law by the USPTO, and highlight the errors in the current rejection. The current analysis represents a misinterpretation of the law and a misconception of the requirements for a practical application. As specified by the law, and evidenced by the identified patents, practical application is not a matter of physical transformation, but rather consequence of the invention in the real world.

Data classification has value in the real world and is not a mere abstract idea. The claimed invention is not directed to a linear programming formulation applied to abstract numbers, but rather to the practical application of selecting an input set for a support vector machine classifier for data classification. The selection of an input set for a support vector machine classifier is not an abstract idea per se, nor merely a mathematical algorithm in the abstract.

In view of the remarks above, Applicant respectfully requests withdrawal of the rejection under section 101.

#### **Claim Rejection Under 35 U.S.C. § 112**

In the Office Action, the Examiner rejected claims 1-57 under 35 U.S.C. 112, first paragraph. The Examiner indicated that such a rejection is required in view of the section 101 rejection. Without addressing this contention in detail, Applicant respectfully submit that the claimed invention satisfies the subject matter eligibility requirements of section 101, for the reasons expressed above. Therefore, it follows that the rejection under 35 U.S.C. 112, first paragraph, should be withdrawn, as the disclosure clearly is sufficient to enable one skilled in the

art to make and use the invention for a practical application, e.g., data classification, without undue experimentation.

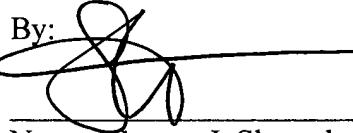
### **CONCLUSION**

All claims in this application are in condition for allowance. Applicant respectfully requests reconsideration and prompt allowance of all pending claims. Please charge any additional fees or credit any overpayment to deposit account number 50-1778. The Examiner is invited to telephone the below-signed attorney to discuss this application.

Date:

September 5, 2006

SHUMAKER & SIEFFERT, P.A.  
8425 Seasons Parkway, Suite 105  
St. Paul, Minnesota 55125  
Telephone: 651.735.1100  
Facsimile: 651.735.1102

By: 

Name: Steven J. Shumaker  
Reg. No.: 36,275